Influence of Social Networks on Cyber Security

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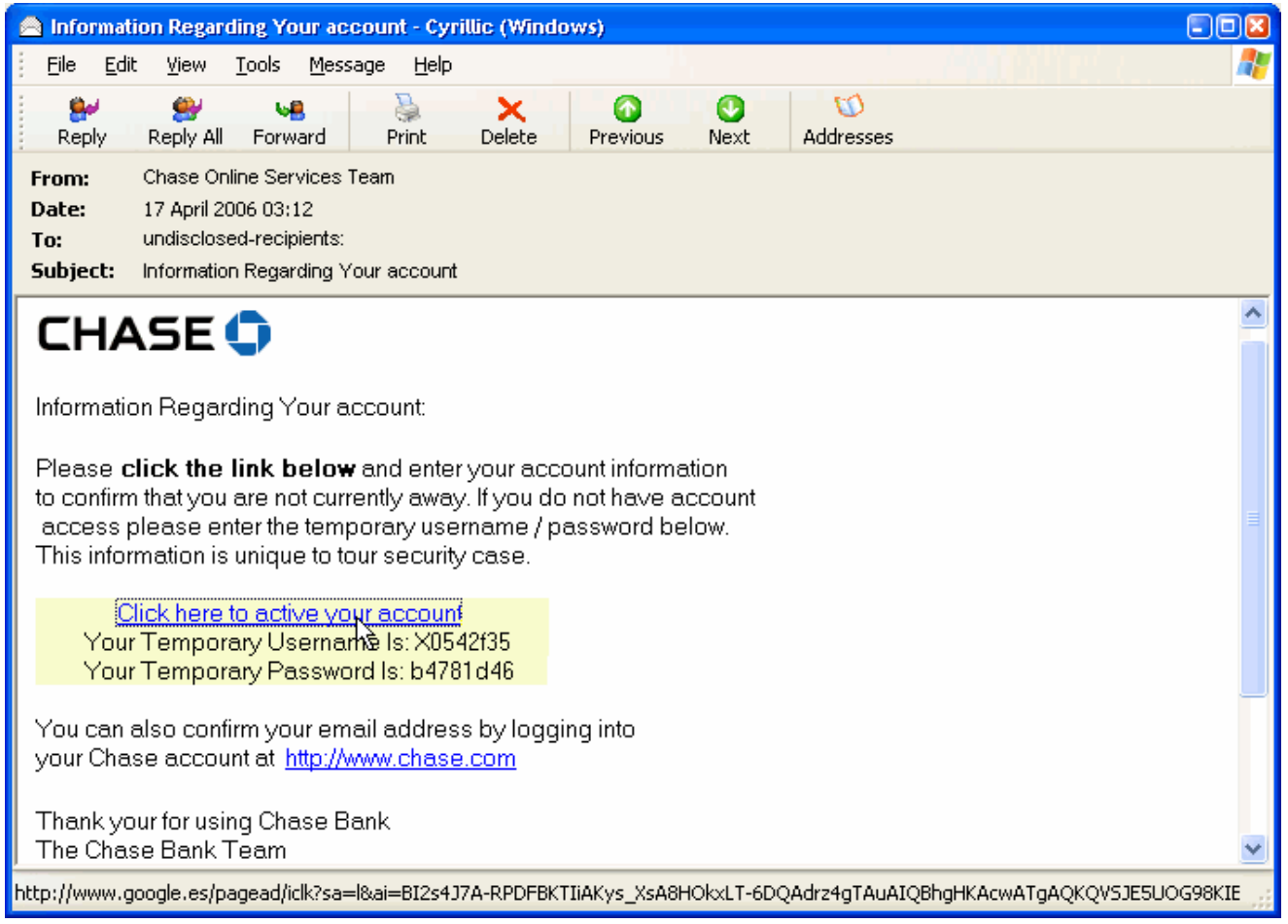
Study Objective

- Examine cadet social networks at the US Military Academy to identify network metrics and processes associated with security vulnerabilities.
- Identify social mechanisms to improve security among college aged cadets at the US Military Academy at West Point.
- Compare processes between formal versus informal networks.

What is Phishing

- Phishing is a form of electronic deception in which an attacker tries to obtain personal information by mimicking a trustworthy entity.



Background

- Phishing attacks are becoming widespread and costly - $2.4M-$9.4M in fraud losses per year
- Future military officers are especially vulnerable – access to sensitive data.
- Phishing threaten personal and national security
- Younger generations are more susceptible - more trustworthy and less fearful of technology.
- Homophily around risky behaviors exists among friends but not clear evidence for organizational links.

Study Design

Part of a large scale Army-wide initiative to evaluate security training

- Training Assessment Study (n=894)
  - Send false phishing emails out to students
  - Longitudinal design – 3 time points over 1 year
  - 9 military units assigned to 1of 3 conditions: (1) no notification, (2) notification, (3) given a 10-minute training module online
  - Findings showed that upper classmen, females and those in cond2 had the greatest reduction in phishing failures (Results published CISSE, 2011)

Social Network Study (n=128)

Network Data

– *INFORMAL NETWORK*
Friendships: “Who do you consider a friend within the company”

– *FORMAL NETWORK*
Chain of command: immediate supervisorial chain

Dependent Variables

– *PHISHING BEHAVIOR*: Detect whether student clicked the embedded link, and entered credentials

– *WARNING ACTIVITY*: Warn another cadet within the company (paper survey)

Analysis:

Correlations & Logistic regression

→ *centrality*

→ *network exposure (# alters that show phishing and warning behaviors)*

Participants

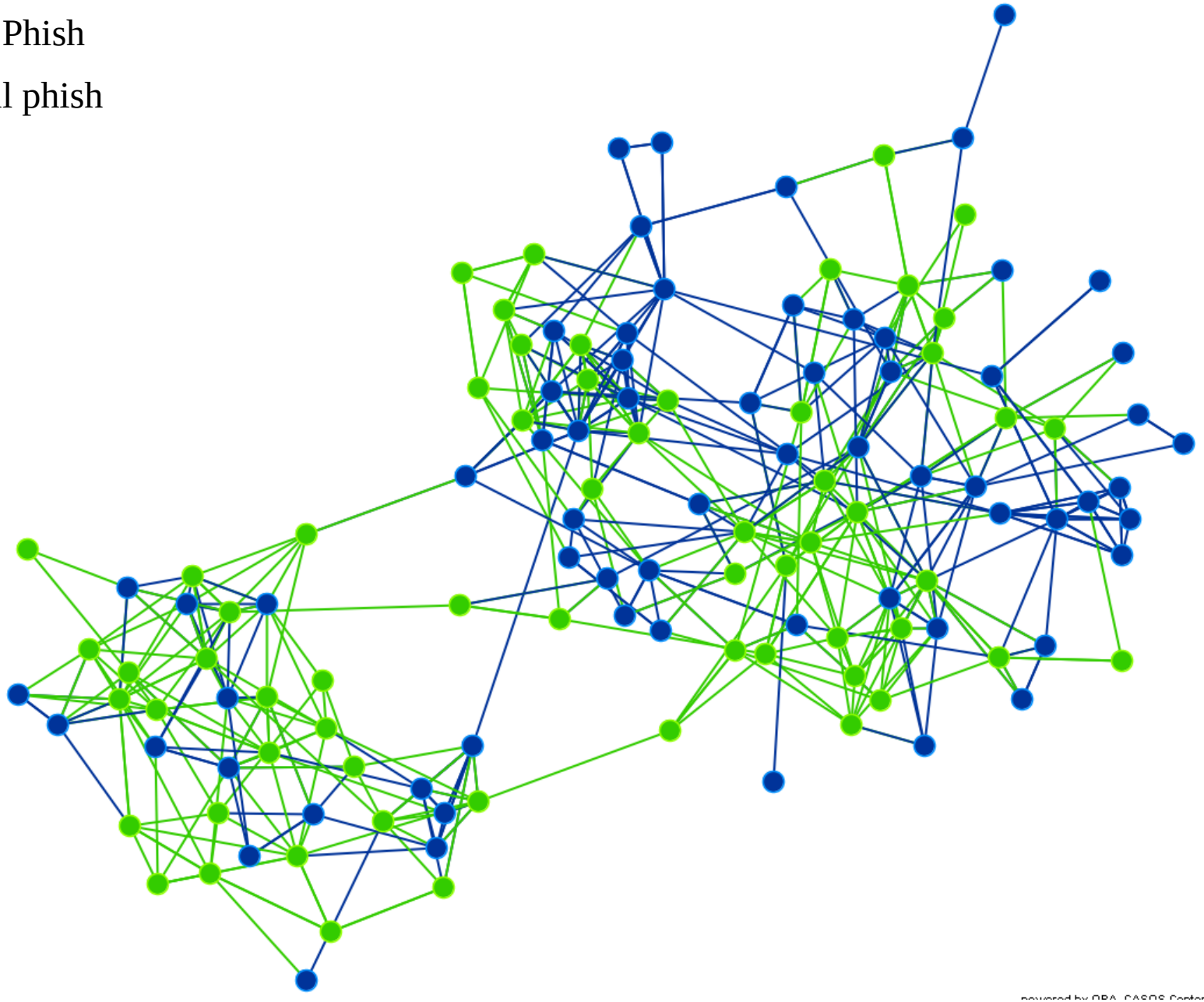
- Participants:
  - US Military Academy cadets, aged 18-25
  - One complete military unit (n=128)
  - 89% males
  - 30% freshman, 28% sophomore, 22% junior, 20% senior

- Security
  - 48% clicked the embedded link
  - 30% entered credentials
  - 5% warned others

FRIENDSHIP NETWORK

Failed Phish

No Fail phish

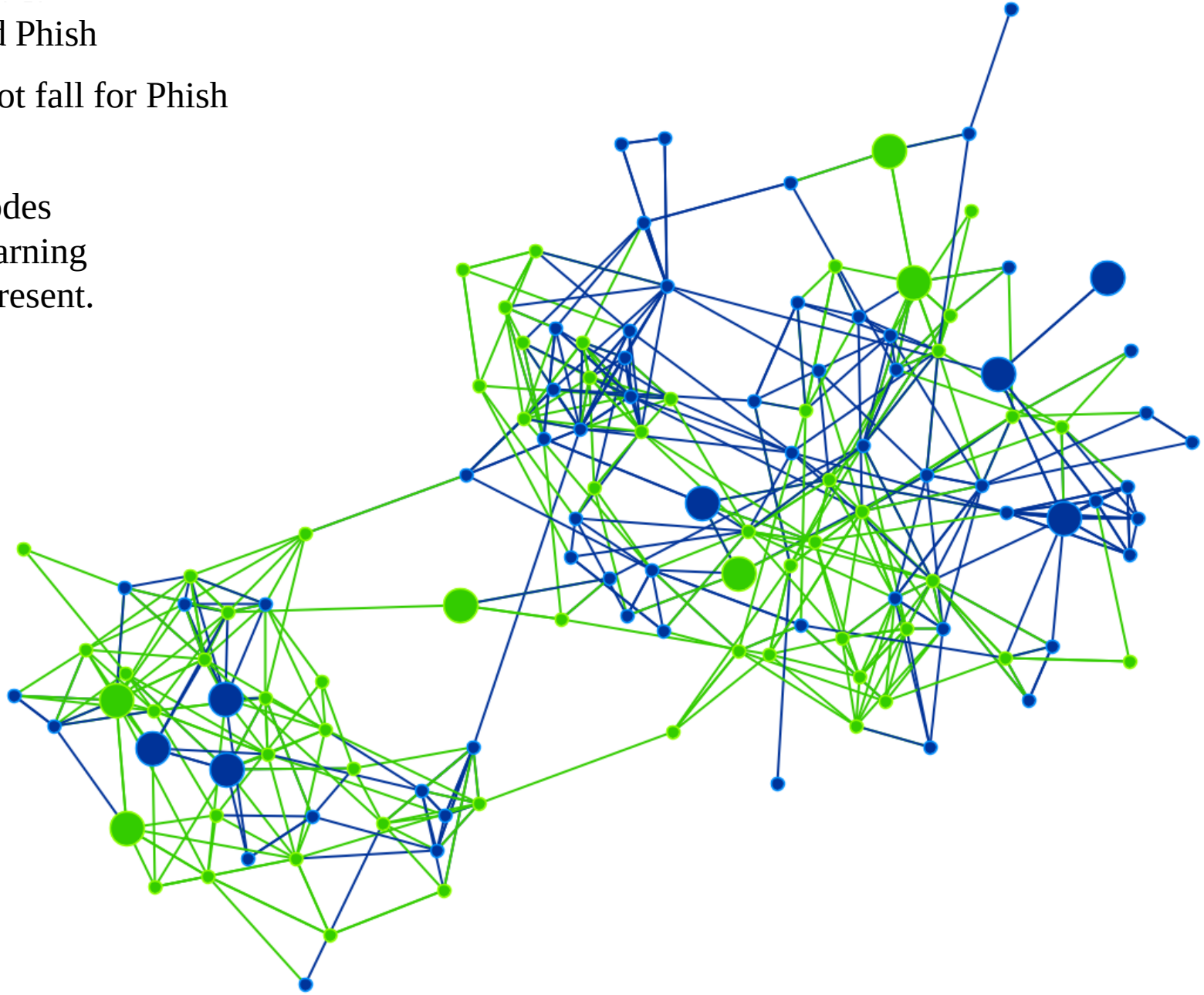


FRIENDSHIP NETWORK

Failed Phish

Did not fall for Phish

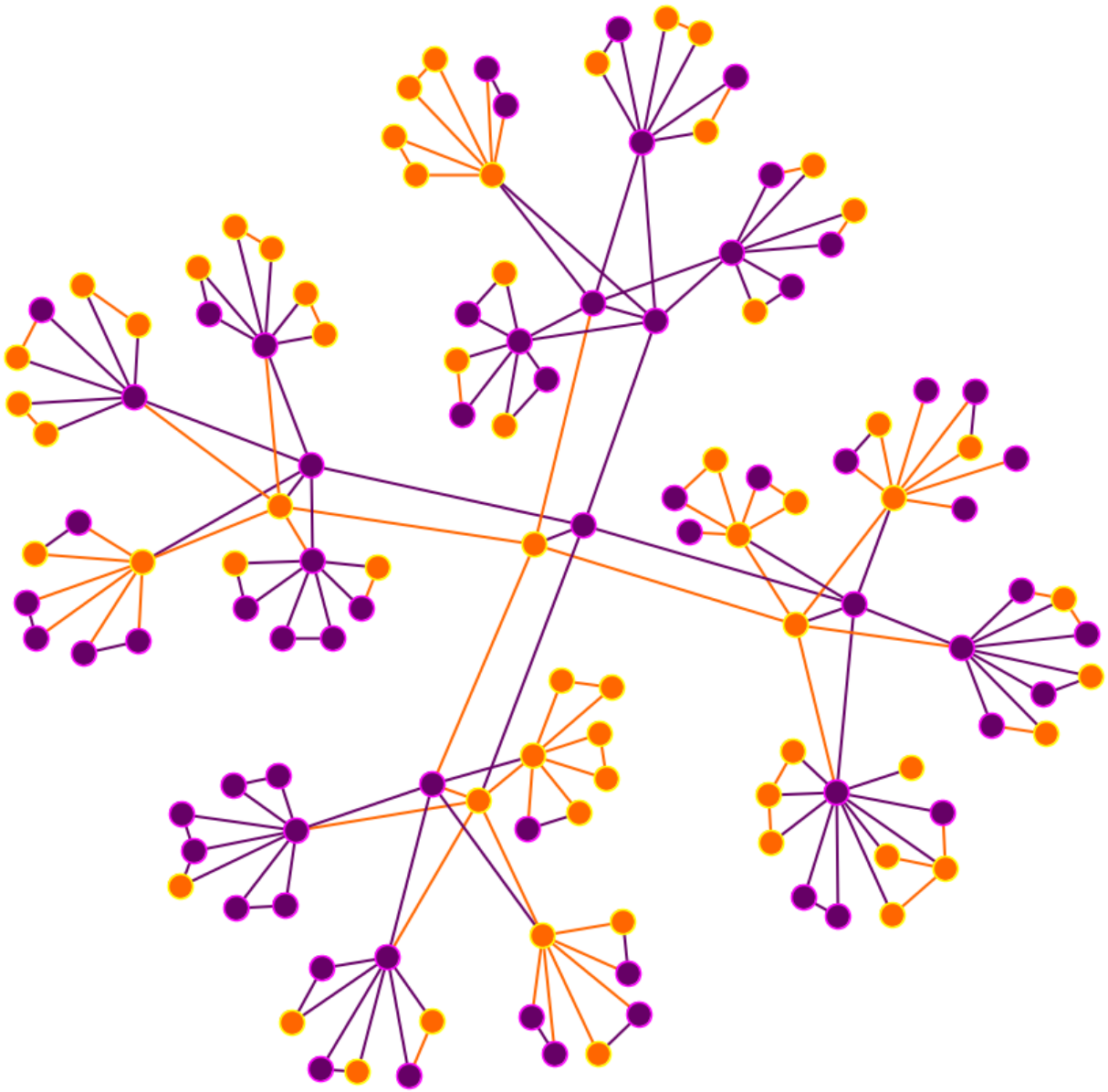
*Larger nodes indicate warning behavior present.



CHAIN OF COMMAND NETWORK

Failed Phish

Did not fall for Phish



CHAIN OF COMMAND NETWORK

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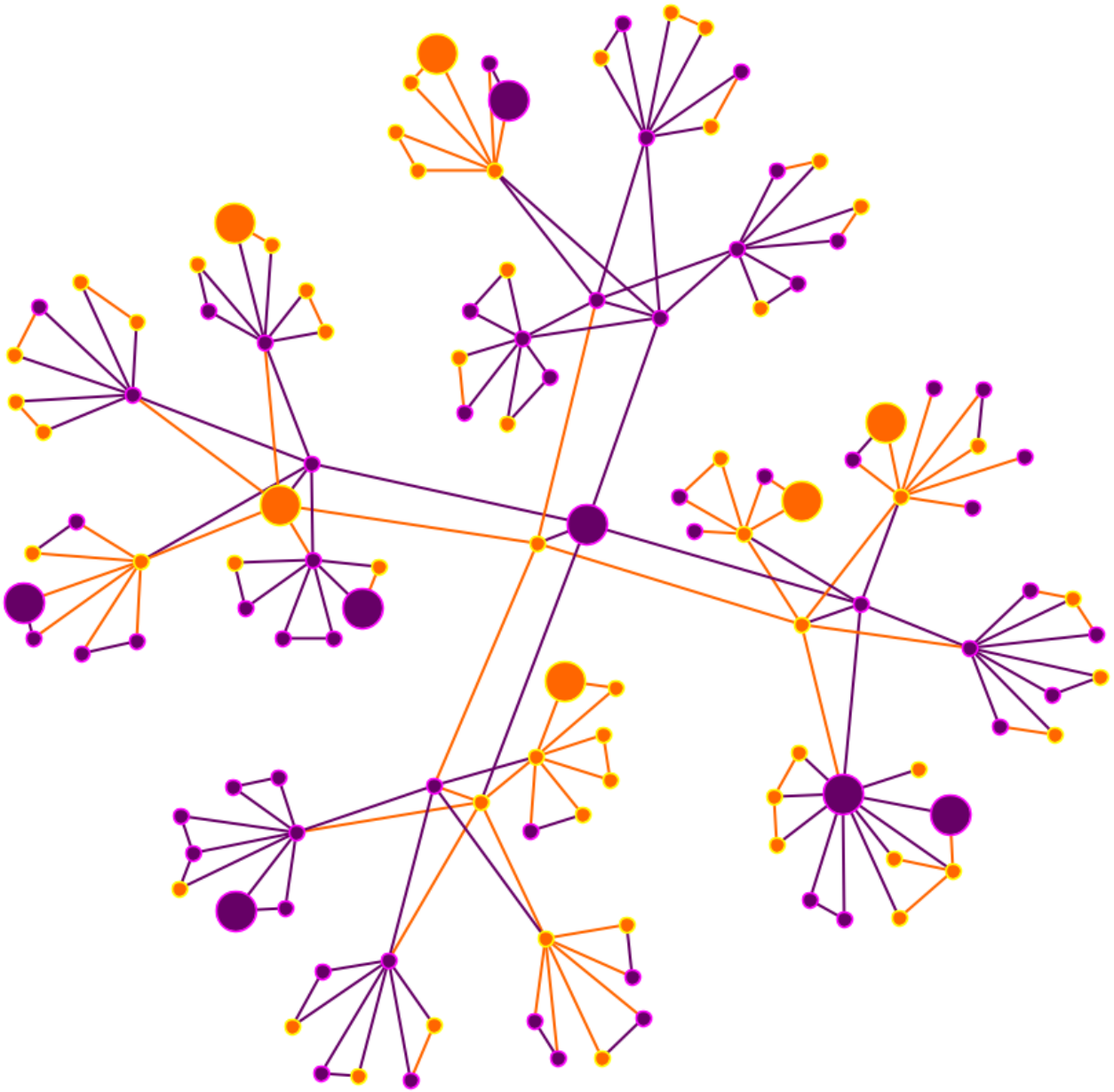

Centrality

	Failure		Warning	
CENTRALITY	*Command*	*Friendship*	*Command*	*Friendship*
closeness	-0.05	0.08	0.23	-0.19
betweeness	-0.12	0.05	0.01	-0.02
eigenvector	-0.05	0.03	0.11	-0.17
indegree	0.08	0.05	0.04	0.06
outdegree	-0.12	0.16	0.02	-0.02

Command leadership correlates with:

- security resilience (decreased phishing failure)
- warning

Informal leadership correlates with:

- failure
- no warning

Local Network Homophily

Logistic Regression of Failure

	Odds Ratio	se	p-value
warn	1.21	0.75	0.754
male	1.17	0.70	0.795
class year	0.81	-0.15	0.235
CoC failure exposure	0.70	-0.12	0.033
CoC warning exposure	2.28	0.83	0.025
constant	1.62	1.16	0.496

Logistic Regression of Warning

	Odds Ratio	se	p-value
fail	0.80	0.50	0.728
male	0.38	0.29	0.199
class year	1.00	0.28	0.996
friend warning exposure	2.32	0.89	0.028
constant	0.16	0.17	0.092

- *Command* relations are involved with *phishing vulnerabilities*
- *Friend* relations are involved with *warning behaviors*

FRIENDSHIP NETWORK

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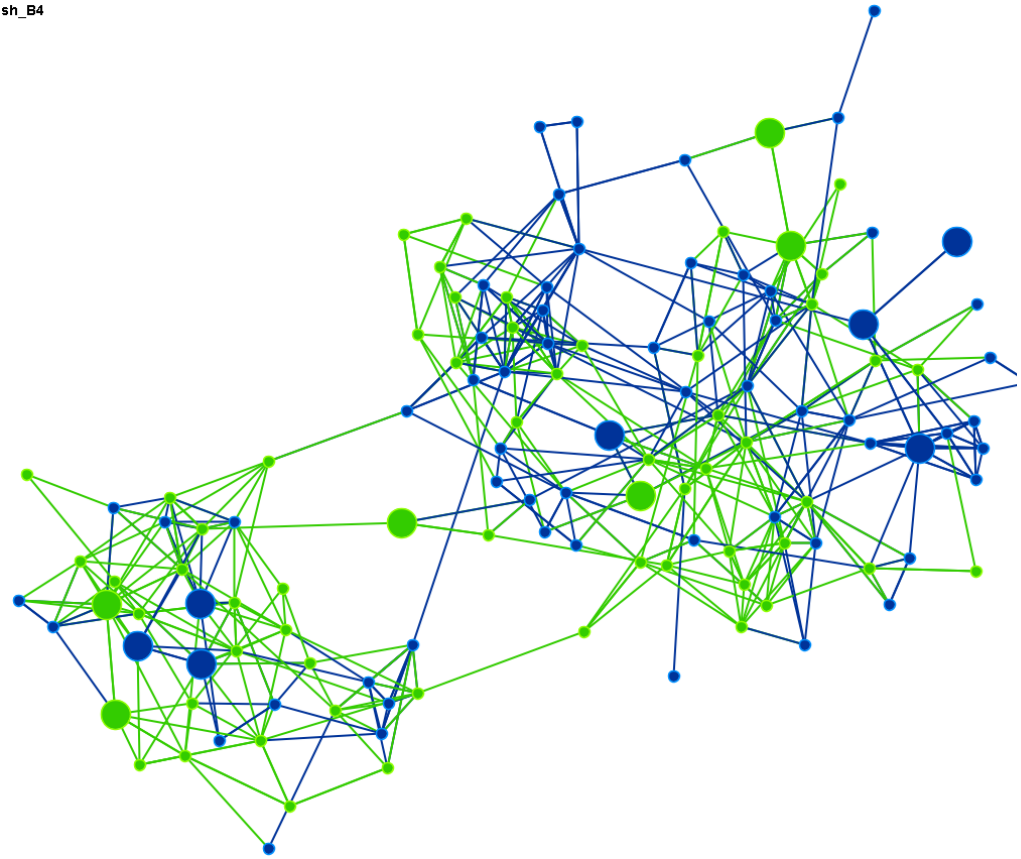
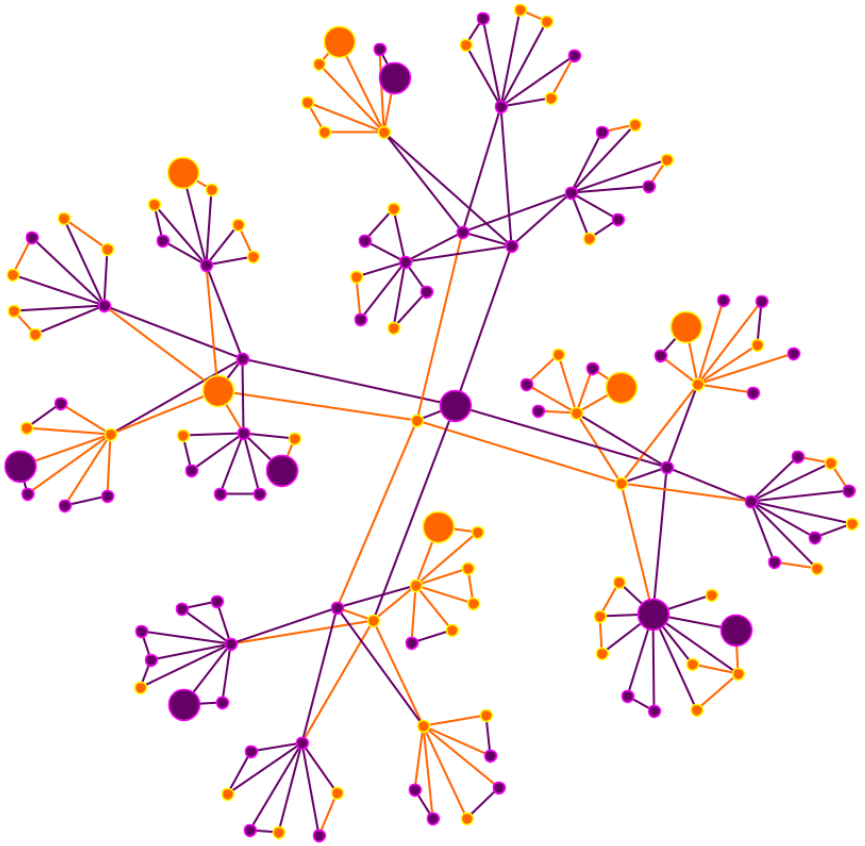


Failed Phish

COMMAND NETWORK



Failed Phish

*Larger nodes indicate warning behavior present.

FRIENDSHIP & COMMAND

Failed Phish

Did not fall for Phish

*Larger nodes indicate warning behavior present.

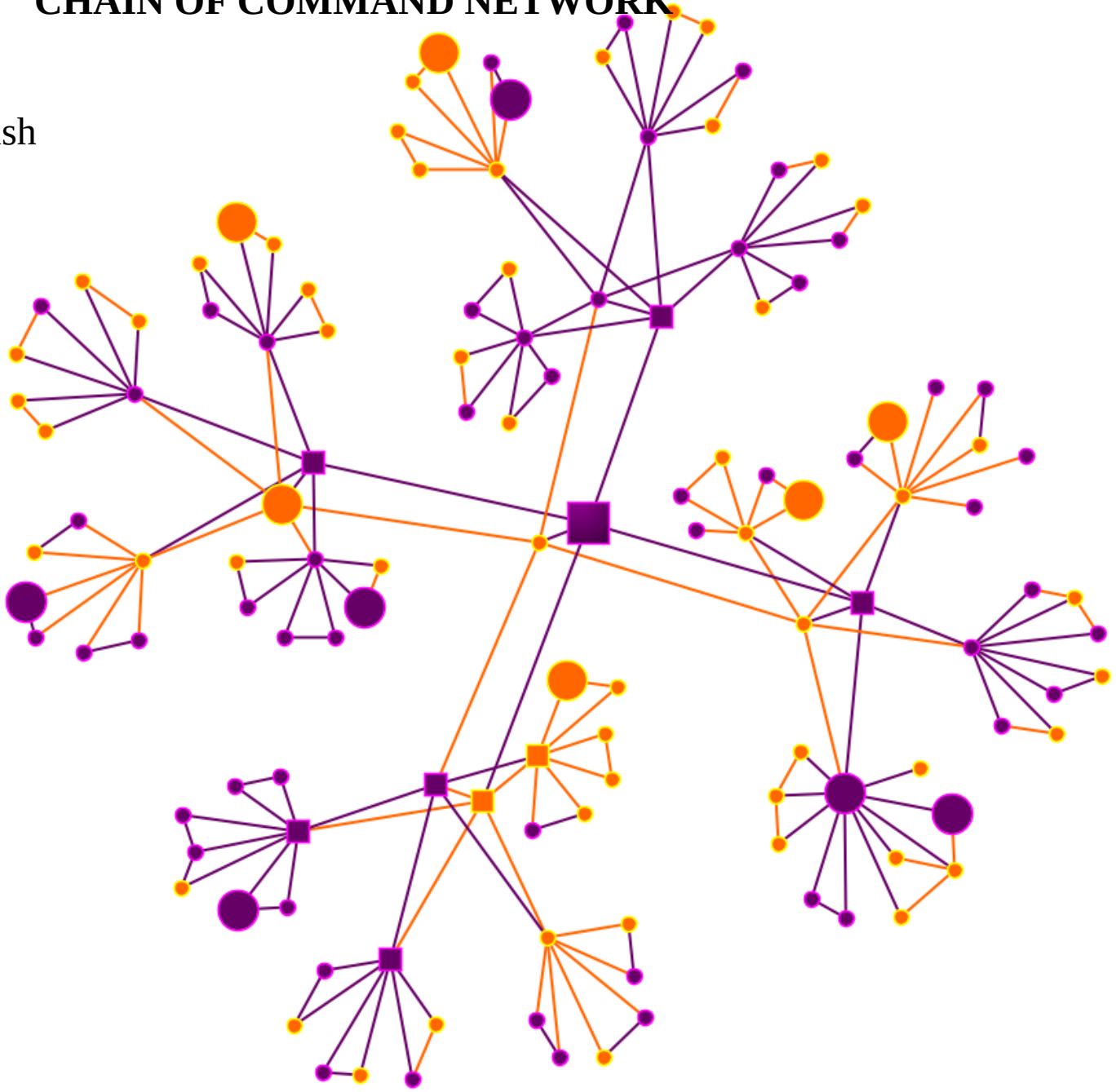
CHAIN OF COMMAND NETWORK

Failed Phish

Did not fall for Phish

*Larger nodes indicate warning behavior present.

*Square shaped nodes indicate friendship ties.



Structural Capabilities

- Friendship networks
  - Characterized as being highly centralized and clustered - few individuals have key roles in spreading information.
- Command networks
  - Have the potential to be very efficient - all individuals in the network can be reached with fewer number of steps (2 versus 5 steps, on average).

	Friendship	**Command Chain**
Link Count	600	198
Density	0.036	0.012
Average Distance	5.020	2.009
Betweenness	0.259	0.002
Closeness	0.042	0.708
Total Degree	0.058	0.036

Summary of Results:
Social determinants of Cyber Security

Informal Social Structure

1. Friendship leadership is vulnerable – more failure, less warning

2. Cyber risk resiliency among friends - while there is less **warning** among friends, there is homophily around this behavior

Formal Command Structure

1. Command leadership is strong – less failure, more warning.

2. Cyber risk vigilance among commanders/subordinates -- reduced security failures ego corresponds to higher **failures** and lower warnings in one's network.

Multiplex Relations

1. Trust improves security coordination -- Warning was likely given and headed among those who share friendship and command links

Future Work

- Security training and research should:
  - Emphasize the importance of security vigilance (failure) among formal leadership structures
  - Harness positive behaviors among informal relations (warning)
  - Further explore the role of multiplex relations in these settings
  - Utilize high betweenness in friendship network, and high closeness in command network

- Currently, conducting phishing study – 3 waves. Collecting network, org identity, and trust survey data.
- Understand other ideological, information exchange and contagion processes among formal and informal networks in military units – leadership, ideology, morale, leadership, performance.

Questions?

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